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ASSESSMENT OF NURSES' KNOWLEDGE AND PRACTICES REGARDING THE MAINTENANCE, CARE, AND PREVENTION OF CENTRAL VENOUS CATHETER-RELATED INFECTION IN ADULT INTENSIVE CARE UNITS IN A MILITARY HOSPITAL

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Abstract

Central venous catheter insertion is not a benign procedure, it is a potentially harmful one, if it is not performed correctly, and it might result in life threatening complications. It causes substantial morbidity, mortality and incurs high costs; they are preventable through the adherence to strict guidelines by health care workers when caring for patients.

A cross-sectional descriptive design was utilized in conducting the study, in a military hospital. The hospital provides inpatient and outpatient services to military personnel and their families, as well as to civilian people. Subject: A purposive sample was composed of 50 nurses who worked at the adult Intensive Care Unit in a military Hospital. The tool data were collected using a self-administered questionnaire to assess knowledge of ICU nurses related to the maintenance, care, and prevention of central venous catheter-related infection and an observation checklist to assess their practices.

The results showed that 70 % of nurses had an average level of total knowledge, 52% had an incompetent level of practice to maintenance, care and prevention of central venous catheter-related infections. There were significant differences between nurses' characteristics and their knowledge, practices. here was a positive correlation between the nurses' knowledge, practices related to the Maintenance, Care, and Prevention of Central Venous Catheter-Related Infection.

Key words: Central Venous Catheter-Related Infection, Adult Intensive Care Units, Nurses role.

Introduction

Central venous catheters are widely used for critical patients and particularly in critical care units since 1929 (Beheshti, 2011). CVCs are inserted into deep veins; as subclavian, jugular, or femoral veins, into vena cava to check hemodynamic change, drug administration, nutrition, or blood withdrawal (Konner, 2005). There are many different CVC types, including peripheral and central catheters, tunneled and non-tunneled catheters, and vascular access devices with or without implanted ports (CDC, 2017). A central line-associated bloodstream infection (CLABSI) is a laboratory-confirmed bloodstream one may be due to infective agents from pneumonia, urinary tract infection, or even gastrointestinal tracts or mucosa by chemotherapy difficult to control without an interprofessional team (Hallam *et al,* 2018). Moreover, there are risky complications of central venous cannulation and can occur at any time during infusion therapy (Fang *et al,* 2017). These include artery puncture, pneumothorax, hematoma, cardiac arrhythmias & venous perforation, or induce phlebitis, thrombus formation, air embolism, nerve injury associated with h mortality rates (Yasuda *et al,* 2021).

The iinfection control practices, including care of IV administration sets and catheter sites, are undertaken by nurses or physicians in an attempt to avoid infection, but post-insertion catheter care is a nursing responsibility, providing an opportunity for nursing care to control infection rates (Kolikof *et al,* 2024). Generally, the quality measures include: Hand hygiene, maximal sterile barrier precautions, Chlorhexidine skin antisepsis, appropriate insertion site selection and prompt removal of unnecessary catheters (CDC, 2017).

Study Rationale: Nurses have important roles

in the maintenance, care, and prevention of central venous catheter-associated infections, so, they must have the ability to know how to prevent complications associated with central line insertion and provide high-quality patient care, improve health and decrease the length of hospitalization and therefore, decrease the health care cost. However, little is known and carried out regarding nursing care of patients with CVCs and there are no accurate statistics about the incidence of Central venous Catheter-Associated Infections in Egypt. This is in addition to scarce research about Central venous Catheter-Associated Infections Thus, the present study was carried out to establish a baseline data about nurses' knowledge and practices regarding this important aspect of patients care. Such data can be incorporated into the future plan of care, upgrade nurses as one of health team members, and might generate an attention and motivation for further research in this area and it is the belief of the researcher that focused assessment of the current state of military hospitals could help in their subsequent improvement.

Research question: What is the level of nurses' knowledge regarding the maintenance, care and prevention of central venous catheter-related infections in adult intensive care units in a military hospital?

What is the level of nurses' practice regarding maintenance, care and prevention of central venous catheter-related infection in adult intensive care units in a military hospital?

The study aimed to assess nurses' practice regarding the maintenance, care and prevention of central venous catheter-related infections in the adult intensive care unit in a military hospital, Also, to address a point of strength and weakness in their knowledge and practices.

Subject and Methods

Study design: This was cross-sectional descriptive design included research design, study setting, study subject and data collection.

Setting: The study was conducted in a military hospital with seven buildings, which offers all medical services to military personnel and their families, as well as to civilians.

The study included 50 nurses regardless of age, sex and experience (minimum one year) at intensive care unit. Two tools were used for the data collection:

I: Self-administered knowledge questionnaire (Appendix I):

This tool was designed based on the review of literature and guidance of the supervisors in simple Arabic language and it was composed of two parts:

Part I: Characteristics of the nurses included: gender, age, nursing qualification, years of experience, years of experience in ICU, job position, rank, and attendance of training postgraduate courses or previous formal or informal education related to the Central Line-associated Bloodstream Infection (CLABSIs) in the critical care unit.

Part II: Nurses' knowledge Assessment Questionnaire. Tool was developed after reviewing the related recent literature and in light of The Joint Commission International (JCI) for preventing central venous catheter-associated infections (CDC, 2017), consisted of (40) questions in the form of multiple-choice questions to assess the knowledge of ICU nurses regarding maintenance, care and prevention of central line stream infection questions involving the following items:

Nurses' knowledge regarding central venous catheter consisted of (12) questions covered the following; definition, indications, types, sites of insertion, equipment used for the insertion, complications and care. Nurses' knowledge regarding central venous catheter-associated bloodstream infection consisted of (10) questions covering the following; definition, risk factors, routes of infection, causative organisms, clinical presentation, diagnosis, prevention and treatment .Nurses' knowledge as to CVC maintained bundle consisted of (18) questions covering the following; replacement of CVC, hand hygiene, dressing change, disinfection of hubs & lumens and changing of administration sets.

Scoring: The correct answers scored one grade, and the incorrect answer scored zero. These scores summed up and converted into a percent score. For each area of knowledge, the scores of items were summed-up and total was divided by the items' number to have a mean score for the part. The scores were converted into a percent, and mean SD were computed. Nurse's knowledge was considered satisfactory if the percent score is 60% or more and unsatisfactory if less than 60%.

II: Observational Checklists: An observation checklist prepared after reviewing the literature on central line care to assess critical care nurses' practices regarding the central line care bundle. Nurses' practice consisted of three stages of central line care (pre, during and after) procedure line. This tool is adapted from the joint commission for preventing central venous catheter-associated infections (2017), and the Asia Pacific Society of Infection the Control (APSIC, 2015). It was used to assess nurses' practice toward central line maintenance bundle. It involved five components that were daily review of line necessity & replacement, hand hygiene, disinfection of hubs, the strict aseptic technique for dressing changes, and standardized administration set changes.

Scoring: Scoring system determined as, answers correct answer was scored "1", and incorrect was scored "0". For each area, scores were summed up and divided by number of items to have a mean score for each part. Scores were converted into a percent & means ±SD. Practice was considered adequate if score was >60% or more and inadequate if < 60%.

The operational design included a preparatory phase, pilot study, and fieldwork:

1- Preparatory phase: This included reviewing literature related to of the knowledge questionnaire and the observation checklist. The tools were developed and reviewed by experts in the medical and nursing fields for face and content validity.

2- A pilot study was carried out on 10% of nurses (5) working in Intensive Care Units and to estimate the time needed for answering all questions. Tools and timetable were finalized according to the pilot data. A few modifications were done to have more feasible checklist. The pilot study was not included in the main data.

3- Fieldwork: Upon the final tool based on the pilot study results, data collection was carried out during the period from November 2022 to February 2023 after obtaining official permission to conduct the study. Data was collected three days per week from 6:00 am to 14:00 pm. The authors met each nurse, explained to her/him the purpose of the study, and asked for her/him oral consent to participate in the study. The self-administered questionnaire were distributed and filled out by participants. The authors clarified any ambiguities. A participant direct observation technique used as the member of the team in the study setting. Each nurse observed for practice during the provision of direct care.

Administrative design: The protocol was approval by the Military Medical Academy, Director of the Military Hospital and Chief Nursing. The study was explained to all and participating nurses were informed about confidentiality

Statistical analysis: Data were computerized and analyzed using the statistical package for social sciences, version 22.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as M ±SD, as frequency and percent. Comparison between groups was done by Chi-square test (for < 5) or Fisher's exact test instead. Correlation coefficient (r) test assessed the degree of between two variable sets. Confidence interval was set to 95% with accepted error at 5%. So, to probability, P <0.05 was significant, but P >0.05 was insignificant.

Results

Socio-demographic data showed that nurses (90%) were in age group 20-30 (26.78±4.55) and females (76%), males (24.0%) and (54%) of all were urban. Nursing carried school diploma (40%), training courses (98%), & (40%) with experience >5-10 years.

Nurses (66%, 68% & 74%) of had satisfactory knowledge as to definition of central venous catheter insertion; central line-associated blood

stream infection & maintenance and central venous catheters handling, respectively. Knowledge about central venous catheter insertion showed 70% satisfactory, and 30% not satisfactory (28.30±2.37). High significant was between total knowledge level as to central venous catheter insertion, years of experience (P <0.001), without significant between knowledge level and age, sex, residence, & training (P>0.05). High significant was between total practice level as central venous catheter insertion according to education level and years of experience (P <0.001), but without significant as to age, sex, residence, and training courses (P>0.05), also significant positive relation was between total knowledge and practice scores of (r=0.493 & p<0.001).

Details were given in tables (1, 2, 3, 4 & 5) and figures (1, 2 & 3)

Table 1: Distribution of nursing according to their socio-demographic data (N=50).

Socio-demographic data	No.	Percentage
Ages: 20-30 years	45	90.0
>30-40 years	5	10.0
>40-50 years	0	0.0
Mean ±SD	26.78±4.55	
Male	12	24.0
Female	38	76.0
Residence: Urban	27	54.0
Rural	23	46.0
Education Nursing school diploma	20	40.0
Technical	17	34.0
Bachelor	12	24.0
Master	1	2.0
Years of experience <1-3 years	10	20.0
>3-5 years	16	32.0
>5-10 years	20	40.0
>10 years	4	8.0
Training courses Yes	49	98.0
No	1	2.0

Table 2: Distribution of nursing knowledge regarding central venous catheter insertion (N=50).

Domains	Satisfactory >60%		Unsatisfactory <60%	
	No.	%	No.	%
Definition of Central venous catheter insertion	33	66.0%	17	34.0%
Central line-associated blood stream infection	34	68.0%	16	32.0%
Maintenance and handling of central venous catheters	37	74.0%	13	26.0%

Table 3: Distribution of nursing total knowledge regarding central venous catheter insertion (N=50).

Level of knowledge central venous catheter insertion	No.	Percentage
Satisfactory >60%	35	70.0
Unsatisfactory <60%	15	30.0
Total	50	100.0

Table 3: Relation between nursing knowledge level regarding central venous catheter insertion as to socio-demographic data

Socio-demographic data	Satisfactory (n=35)		Unsatisfactory (n=15)		Chi-square test	
	No.	Percentage	No.	Percentage	x2	P-value
Ages: 20-30 years	32	91.4%	13	86.7%	*FE*	0.607
>30-40 years	3	8.6%	2	13.3%		
Male	9	25.7%	3	20.0%	*FE*	0.665
Female	26	74.3%	12	80.0%		
Residence: Urban	20	57.1%	7	46.7%	0.464	0.496
Rural	15	42.9%	8	53.3%		
Education :Nursing school diploma	6	17.1%	14	93.3%	*FE*	<0.001**
Technical	16	45.7%	1	6.7%		
Bachelor	12	34.3%	0	0.0%		
Master	1	2.9%	0	0.0%		
Experience: <1-3 years	0	0.0%	10	66.7%	*FE*	<0.001**
>3-5 years	12	34.3%	4	26.7%		
>5-10 years	19	54.3%	1	6.7%		
>10 years	4	11.4%	0	0.0%		
Training courses: Yes	34	97.1%	15	100.0%	*FE*	0.508
No	1	2.9%	0	0.0%		

Using: Chi-square test & FE: Fisher's Exact, P >0.05 NS; *P <0.05 S; **P <0.001 HS

Table 4: Relation between level sof nursing practice regarding central line insertion checklist as to socio-demographic data.

Socio-demographic data	Adequate (n= 24		Inadequate *(n=26)*		Chi-square test	
	No.	%	No.	%	x2	p-value
Ages: 20-30 years	22	91.7%	23	88.5%	*FE*	0.706
>30-40 years	2	8.3%	3	11.5%		
Male	6	25.0%	6	23.1%	0.025	0.874
Female	18	75.0%	20	76.9%		
Residence: Urban	13	54.2%	14	53.8%	0.001	0.982
Rural	11	45.8%	12	46.2%		
Education :Nursing school diploma	2	8.3%	18	69.2%	*FE*	<0.001**
Technical	11	45.8%	6	23.1%		
Bachelor	10	41.7%	2	7.7%		
Master	1	4.2%	0	0.0%		
Experience: <1-3 years	0	0.0%	10	38.5%	*FE*	<0.001**
>3-5 years	5	20.8%	11	42.3%		
>5-10 years	15	62.5%	5	19.2%		
>10 years	4	16.7%	0	0.0%		
Training courses: Yes	23	95.8%	26	100.0%	*FE*	0.293
No	1	4.2%	0	0.0%		

Table 5: Total scores of knowledge and practice as to central venous catheter insertion checklist.

Variations		Total knowledge score	Total practice score
Total score of knowledge	R		0.493
	P-value		<0.001**
	N		50
Total score of practice	R	0.493	
	P-value	<0.001**	
	N	50	

r-Pearson Correlation Coefficient; *P <0.05 significant and **P<0.001 highly significant

Discussion

Generally speaking, central-venous-catheter-related bloodstream infections (CRBSIs) are the important cause of hospital-acquired infection associated with morbidity, mortality, and costs (Gahlot *et al,* 2014). The difference rates varied from a country to another leading to difficulty in the care and treatment of patients (Soufir *et al,* 1999). Lorente *et al*. (2005) in Spain reported the CRBSI incidence of 2.79 infections 1000 catheter days, among which CVC were responsible for 2.09% of cases. Singh *et al*. (2010) in India reported the overall infection rate for CRBSI was 0.48/1000 device days. Also, Parameswaran *et al*. (2011) in India found that CRBSI incidence was 8.75/1,000 cathter days. However, Maki *et al.* (2006) in USA reported that the incidence of CRBSI reported varied even from hospital to hospitals. They added by meta-analytical study done at Johns Hopkins University bloodstream infections (BSIs) were the third leading cause of nosocomial (hospital-acquired infections) with a mortality rate of 12% to 25%. Consequently, nurses play an important role in preventing central venous catheter-associated bloodstream infection (CVC-BSI) by keeping their knowledge up to date and combining evidence-based information with practice (Buetti *et al,* 2022). In the current study, majority of participating nurses were in age group 20-30 with (26.78±4.55) years. This disagreed with Abdo *et al*. (2020), who assessed the effectiveness of an educational program on knowledge and practices of nurses cared of central venous catheters among dialysis nurses, reported that 50% of them were in age group31-35 years (35.73±4.66). This may reflects the demanding nature of critical care unites service, so that older nurses may find it difficult to cope with the load of work required and prefer the newly graduate to work in the critical care units, as they had the ability to acquire knowledge and change their behaviors.

In the present study, the majority of nurses were females. Generally, the great majority of

the nurses in Egypt are females. Also, Elgazar *et al.* (2020) studied an educational program on nurses' performance as to vascular access infection prevention, reported that the majority of them in intensive care unit and central venous access device were females.

In the current study, more than half of nurses were from urban areas. This agreed with Abdel Ghafour *et al.* (2021), who found that more than half of the nurses were from urban areas

Regarding to level of education of the studied nurses, the current study result clarified that two fifths of them had a nursing school diploma; this might due to the highly qualified nurses always perform administrative work.

In congruence with these findings, Moursy and Sharaf (2017) who study about "vascular access care at hemodialysis unit; nurses' compliance to infection prevention and control practice" and reported that highly percentage of the studied nurses the educational level were diploma. While This finding was contrasted with Sami and Faris (2018) studied to assess Nurses' compliance with central line associated blood stream infection prevention guidelines: Muslim *et al.* (2018) in hospital Peshawar assessed practice of nursing care for central venous catheter among ICUs nurses in private tertiary care reported that most nurses providing patients' care had bachelor degree of nursing.

In the present study, as to years of experience two fifths had experience >5-10 years. This might be due the expert nurses tend to stay along time in the same field. But, it disagreed with Elbilgahy (2019), who studied educational intervention for nurses' about prevention of Central Line associated blood stream infection, reported nurses who worked in hemodialysis units to care for central venous catheter having 10 years of experience.

In the present study, as training courses, the majority of them had training courses due to the implementation of in-service training program for nurses about CVC. But, this disagreed with Khalifa *et al.* (2021), who assessed effect of educational program for nurses on central venous catheter maintenance bundle for critically Ill Patients, showed that more than three quarters of the studied nurses didn't attend training courses related to caring for central venous catheter. No doubt, nursing attending congresses and/or conferences was low due to their over responsibilities and activities. This agreed with Zeyada *et al.* (2021), they showed that more than three quarters of nurses had poor answer regarding assessment, prevention and care of CVC as knowledge domains of nurses to central venous catheter insertion.

In the present study, two thirds of nurses had satisfactory knowledge as to definition of central venous catheter insertion; more than two thirds of them had satisfactory knowledge regarding central line-associated blood stream infection & less than three quarters of them had satisfactory knowledge regarding maintenance and handling of central venous catheters, respectively. This might be due to their educational background and experience in caring for critical ill patients. As regard total knowledge of the studied nurses regarding central venous catheter insertion, the current study result represented that less than three quarters of them had satisfactory knowledge among the nursing of central venous catheter insertion, meanwhile less than one third had unsatisfactory knowl-edge and mean score was 28.30±2.37. This disagreed with Bayoumi and Mahmoud, (2017), who assessed the effect of education program on nurses' knowledge and practice regarding care of central venous line in hemodialysis, reported that about one tenth of them had satisfactory knowledge about site of insertion. Also, it disagreed with Latha and Gurung (2022), who evaluated knowledge regarding management of patients with central venous access devices among ICU Nurses, found that more than two fifths of the studied nurses had inadequate knowledge, more than half of them had moderately adequate knowledge, and minority of the nurses had adequate knowledge regarding central venous access device. This showed that nu-rses had moderately adequate knowledge. As to studied nursing domain of practice according to their

central line insertion checklist, the present study result observed that more than three quarters of the studied nurses had adequate reported practice regarding to during the procedure & half of them had adequate reported practice regarding to after the procedure, respectively. While, more than half of them weren't inadequate reported practice regarding to before the procedure & less than three quarters of them weren't inadequate reported practice regarding to handle and maintain central lines appropriately & promptly remove unnecessary central lines, respectively. This might be due to recurrent dealing with patients have CVC. This disagreed with Gulnur and Kazan (2021), who found that nurses had inadequate skills of CVC care applications. Also, Zeyada *et al.* (2021) found that 80.0% of nurses had unsatisfactory practice regarding CVC procedure and majority had unsatisfactory practice as to infection control. Regarding studied nursing of practice to central line insertion checklist, the present study showed that less than half of them had adequate reported practice among studied nursing of central venous catheter insertion, meanwhile more than half of them had inadequate reported practice and the mean score ±SD was 60.66±12.64.This result may be due to Nursing staff shortages, nurses' work overload, low of resources and inadequate supervision could contribute to such a low practice level. This disagreed with Manurung and Dewi (2022), who reported that the majority of nurses had good practices level. Also, it disagreed with Zeyada *et al*. (2021), who found that most of the studied nurses had unsatisfactory total level of practices regarding central line.

In the present study, knowledge regarding the central venous catheter insertion according to socio-demographic data, showed high significant relation between total knowledge level as central venous catheter insertion and education level and experience years (P<0.001), but, with no significant relation between knowledge level and ages, sex, residence, and training courses (P>0.05). Temiz *et al.* (2022) found that the knowledge level of nurses about evidence-based practices in preventing central venous catheter-related infections was not sufficient and negatively affected by the education high level with experience increasing of knowledge level. This agreed with Saltah and Abusaad (2021), who assessed knowledge and practice related to caring of central venous line, found significant differences in nurse's knowledge as to years of experience, which increased with the increase years of experience. But, this disagreed with Awad *et al*. (2019), they in the Emergency Hospital, Mansoura University reported positive significant correlations between ages and years of experience in the ICU nurses and total knowledge. But, there was negative correlations between total knowledge scores and age, years of experience in nursing and in the ICU and there was no significant statistical difference in the mean knowledge scores in relation to age group, education level and attended workshop. The mean knowledge scores differed significantly in relation to experience years in the ICU (F=2.99 at P<0.027).

In the present study, as to relation between nursing practice level regarding central line insertion checklist and their socio-demographic data, there were high significant relation between total level of practice and education and years of experience (P <0.001). But, no significant relation was between level of practice and each of age, sex, residence, and training course (P>0.05). This agreed with Bayoumi and Mahmoud (2017), who found highly significant positive correlation in nurses' practice as to educational level, occupation, experience years and training courses attendance. But, it disagreed with Awad *et al.* (2019), they didn't find significant difference in the mean practice scores as to ages, years of experience in ICU nurses, education level and attended workshop.

In the present study, total score of knowledge and practice regarding central line insertion checklist, the nurses showed significant positive correlation between total mean score of knowledge and practice about central venous catheter insertion (r=0.493 & (p<0.00 respect-

ively). This agreed with Manurung and Dewi (2022), who found significant relationship between the level of knowledge and practice of nurses in preventing wound infections in patients with central venous catheters in hospitals. Said *et al.* (2020) studied factors affecting performance toward central line associated blood stream infection in critical care units, found a high significant positive correlation between total knowledge and total practice ($P< 0.00$).

Conclusion

The outcome results showed that t majority of nurses had satisfactory knowledge as to central venous catheter insertion. But, less than half of them had adequate reported practice among nursing of central venous catheter insertion, meanwhile more than half of them had inadequate reported practice regarding central venous catheter insertion.

Recommendations

1- Nursing education: a- Development of nosocomial infection control training programs for nursing staff in ICU, b- Orientation pro-grams to newly appointed nursing personnel related to infection control measures, c- Infection control guidelines and procedures manuals and protocol of care are indicated for all invasive procedures as CVC insertion in the ICU, and they should be available for all nurses, mainly in ICU, d- Weekly seminars, meeting, and conferences must be held to improve their knowledge, practice, and training programs on central line about bloodstream infection and care to have updated knowledge and enhancing practice, e- Up-to-date Textbooks, posters, and instructions about CVC insertion, care and provision for prevention and infection controls, & f- CVC care procedure on practices must be available for all nurses.

2- Hospital administration: a- Proper design of ICU department to access easily to the decontamination area, and provision of protective barriers necessary for applying feasible infection control at universal precautions, b- Reported control policies, guidelines and procedures related to CVC insertion, care and provision must be present in the ICU, and c- An immunization program must be implemented to all nursing staff in ICU, and periodic medical checkup.

4- Practicing nurses: a- Periodic assessment if ICU nurses performance related to CVC insertion, care and provision to detect their areas of deficient performance, and identify their needs, b- nurses must attend external training courses and conferences to upgrade knowledge and practices in the based guidelines for CLABSI prevention must be incorporated in all nursing curricula, & c- Nurses must use the available central line insertion checklist to decrease mistakes and avoid infection.

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Explanation of figures

Fig. 1: Distribution of nursing domains of knowledge regarding central venous catheter insertion.
Fig. 2: Distribution of nursing domain of practice according to their central line insertion checklist.
Fig. 3: Distribution o d nursing of practice according to central line insertion checklist.